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OFFICE OF
PREVENTION,
PESTICIDES AND
TOXIC
SUBSTANCES

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MEMORANDUM

SUBJECT: Initial Sweet Cherry Benefits Assessment for Azinphos-methyl and Phosmet

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SUMMARY

There should be minimal impact from extension of the REI for phosmet as this product is only targeted to control Syneta beetle in Oregon. Phosmet is not used on other sweet cherries due to phytotoxicity issues.

There could be major impacts on sweet cherry production from extension of the REI for azinphos-methyl. Sweet cherries are not hand thinned (i.e., rely on natural fruit set) but are hand harvested. Extension of the REI would generally cause producers to switch to a product with a lesser REI, a synthetic pyrethroid, for late season pest control. Fruit flies are a major sweet cherry pest and must be controlled within the eight day pre-oviposition period

before the female matures and can lay eggs. Due to California Department of Agriculture regulations, there is a zero tolerance for this pest. Extension of the REI beyond the current label would put the complete crop at risk as a result of using less efficacious alternative insecticides.

BACKGROUND

Cherries occupy the *Cerasus* subgenus within *Prunus*, being fairly distinct from plums, apricots, peaches, and almonds. They are members of the *Rosaceae* family, subfamily *Prunoideae*. *Prunus avium* L. is the sweet cherry. As a group, cherries are relatively diverse and broadly distributed around the world, being found in Asia, Europe, and North America (Marks Fruit Page, http://www.uga.edu/hortcrop/rieger/index.html#Crops, Department of Horticulture, University of Georgia).

Bing, Napoleon, (syn. Royal Ann), and Lambert are the most important cultivars in North America. The Ranier cultivar is rapidly increasing in importance, having unique light-red blush over yellowish skin color; prices received by growers have been well above red-colored cultivars through the mid 1990's. All commercial cultivars exhibit gametophytic incompatibility with themselves and several others, hence cross-pollination and choice of pollinizer is critical.

Cherries grow best on deep, silt loam soils with good internal drainage to prevent root rots. They are one of the few fruits that can be grown without irrigation. However, fruit quality improves with regular watering. Cherries are vigorous trees with strong apical control with an erect-pyrimidal canopy shape and can grow to >50 feet. In cultivation, sweet cherries are maintained at 12 feet in height and planted in solid blocks.

Growers establish sod row middles in the orchards to facilitate use of equipment, reduce erosion, and to prevent pest build up and maintain a bare area under the tree rows with herbicides. Leaves are relatively large, elliptic with acute tips, petioled, and strongly veined. The flowers are white clusters of 2-5 flowers on short spurs with multiple buds at the tips. The distal bud is vegetative and continues spur growth. Spurs are long-lived and may produce for 10-12 years. Bloom occurs relatively late in spring, so frost is less of a hazard than for other stone fruits, except for sour cherries, which bloom slightly later.

Pollination is absolutely essential for production, since sweet cherries are self-incompatible. In order to produce a commercial crop, 25-50% of flowers must set fruit. Thinning is unnecessary for fruit size development, and since a high proportion of flowers must set for a crop, this is not practiced. Bees are the main pollinator. Pollinizers are usually set every third tree in every third row, or in alternate rows. Maximum yields are obtained beginning in the 5-6th year after budding, and trees are productive for 25-30 years. Sweet cherries for fresh market are still harvested by hand, usually by migrant labor or as pick-your-own (Crop Profile for Cherries (Sweet) in Oregon , 1999 and Crop Profile: Cherries in New York, 2000).

Cherry trees complete several physiological stages within the growing season. These stages are used as references from which growers are able to monitor fruit development and time spray applications. The order of stage progression is always the same, however, the time of year varies depending on weather conditions and also on the cultivar being grown. The first stage following winter dormancy is known as silver-tip. During this period, buds begin to swell and the scales separate. When green tissue begins appearing in the bud tips, the green-tip stage has been reached. There are also several phases of blossom development. Full bloom occurs when 70% of all flowers are open, at which point, flower petals begin falling. Following petal fall, the dried flower parts also fall from young fruit. This particular stage is known as shuck split/fall. The first cover spray for pest control is applied approximately two weeks after petal fall with an additional cover spray being applied two weeks later.

Cherries are typically harvested from late June into early July. The time from sweet cherry bloom to harvest is 60 to100 days with an average of 70 days (Crop Profile for Cherries (Sweet) in Oregon, 1999). Pre-harvest intervals (PHI's) should be considered when choosing chemicals for late season sprays.

As with other tree fruit crops, orchard production systems vary depending on the needs of the grower. Cherry production systems should take into consideration that tart varieties generally set fruit with pollen from the same variety while sweet varieties require pollen from other varieties. Once the orchard has been laid out, trees are typically planted within weed-free zones maintained with the application of herbicides, alternating with permanent grass sod alleyways. Within the first 4-5 years after planting, tree canopies are manipulated either by pruning or bending. These processes usually occur during late winter or early spring depending on grower preferences. Sweet cherries are hand-harvested in early summer followed by the mechanical harvesting or "shaking" of tart cherries in mid-summer. Cherries typically receive an average of 4-6 crop protection chemicals/herbicides during the growing season.

Sweet cherries are produced in primarily in 4 U.S. states: CA, MI, OR, and WA. States with minor production include ID, MT, NY, PA, and UT. Acreage and crop values are provided in Table 1.

Table 1. Sweet cherry production and crop value for 2000.[1]

State	Bearing Acreage [2] (Acres)	Yield per Acre (Tons)	Total Production (Tons)	%Total Production	Value of Production (1,000 Dollars)
CA	19,000	2.10	39,900	18.4%	67,822
ID			3,000	1.4%	4,733
MI	7,900	2.48	19,600	9.0%	9,520
MT			1,100	0.5%	1,569
NY	700	1.29	900	0.4%	1,230
OR	11,000	5.00	55,000	25.3%	43,655
PA			500	0.2%	1,090
UT	600	4.00	2,400	1.1%	2,430
WA	18,000	5.28	95,000	43.7%	154,725
Total		3.71	217,400		286,774

Agricultural Chemical Usage 2000 Fruit and Nut Summary, 2001, USDA/NASS

[1] Missing data not published to avoid disclosure of individual operations.

[2] Yield is based on total production.

Total sweet cherry production in the U.S. during 2000 was 217,400 tons (Agricultural Chemical Usage 2000 Fruit and Nut Summary, 2001, USDA/NASS). However, due to unique pest complexes targeted for control with azinphos-methyl and phosmet, sweet cherry production is best divided into a Western Region (including CA, OR, and WA) and a Eastern Region (MI). The Western Region accounts for 87.4% of total U.S. sweet cherry production.

Figure 1 illustrates production and crop value in sweet cherry production over the last 3 years. Overall, production and crop value has increased by approximately 30% since 1991 and 1992.

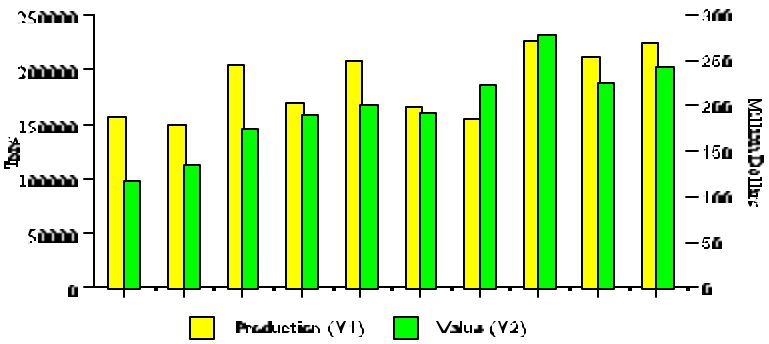

Figure 1. Crop production total (lbs) and crop value ($) for U.S. sweet cherry production from 1990 to 1999.

USE OF AZINPHOS-METHYL AND PHOSMET ON SWEET CHERRIES

Azinphos-methyl: - Azinphos -methyl was applied to 44% of sweet cherry acres during 1999 (Agricultural Chemical Usage 1999 Fruit and Nut Summary, USDA/NASS). There was on average 1.9 applications at a rate of 0.64 lbs. a.i./acre/application.

Table 2. Percent Sweet Cherry Acreage Treated with Azinphos-methyl in 1999 (Agricultural Chemical Usage 1999 Fruit and Nut Summary, USDA/NASS).

Region	Bearing Acreage	Percent Crop Treated
Western (CA, OR, WA)	50,000	36
Eastern (MI)	8,100	86
United States (Total)	58,000	44

Use in the Eastern Region:

Target Pests: - Pests which are targeted for control with azinphos-methyl in sweet cherry production in the eastern U.S. are Cherry fruit fly and Plum curculio (Crop Profile for Cherries in Virginia, 2000 and Crop Profile for Cherries in New York, 2000).

Cherry fruit fly and Black cherry fruit fly

The cherry fruit fly cause damage in two ways: feeding by the adults and feeding by the larvae (Cherry Fruit Fly Fruit IPM Fact Sheet, 1993, Michigan State University, http://www.msue.msu.edu/vanburen/fcfly.htm). Little damage results from the egg puncture itself but a dimple will form if fruit is stung while still green (Crop Profile for Cherries in New York, 2000). Primary damage results from larval feeding within the fruit. Infested fruits appear normal until the maggot is nearly grown, at which time sunken spots appear. Maggots and their frass within the fruit render the product unsalable. Infested fruit is more susceptible to disease (Cherry Fruit Fly Fruit IPM Fact Sheet, 1993, Michigan State University, http://www.msue.msu.edu/vanburen/fcfly.htm).

Peak emergence for the black cherry fruit fly is mid-June while peak emergence of the cherry fruit fly is about harvest (mid to late July). Both flies must be controlled within the eight day pre-oviposition period before the female matures and she can lay eggs (Cherry Fruit Fly Fruit IPM Fact Sheet, 1993, Michigan State University, http://www.msue.msu.edu/vanburen/fcfly.htm).

Plum curculio

Plum curculio can damage cherry fruit in two ways. The wounds resulting from feeding and egg laying by the overwintering beetles in the spring appear as crescent-shaped scars (oviposition injury) on the fruit or as bumps (feeding injury) that protrude from the fruit at harvest. Badly attacked fruit may be knobby, gnarled and scarred at harvest. A second damage results from the internal burrowing by the larvae. Premature fruit drop during June or later may either be the result of larval activity within the fruit or adult feeding (Plum curculio Fruit IPM Fact Sheet, 1998, Michigan State University, http://www.msue.msu.edu/vanburen/plumcurc.htm). Sprays for the plum curculio should be initiated at petal fall with the initial application followed by two or three sprays at 10-day intervals (Plum curculio, 1997, Georgia IPM, http://www.bugwood.caes.uga.edu/factsheets/99-004.html).

Alternative Pest Control Methods: Several alternative pesticides are available to control cherry fruit fly and

plum curculio. However, azinphos-methyl is the most efficacious insecticides for controlling these pests.

Malathion is effective against the cherry fruit fly when the ULV formulation is used. However, the ULV formulation of malathion is rarely used as it is applied by aerial application and aerial applications are rarely used in cherry orchards. Malathion is not effective for plum curculio (Tart Cherry Pest Management in the Future: Development of a Strategic Plan, 2000).

Chlorpyrifos is not effective in controlling cherry fruit fly but can be used early season to control plum curculio. Chlorpyrifos is not as effective as either azinphos-methyl or phosmet against plum curculio but it is better than other alternatives (Tart Cherry Pest Management in the Future: Development of a Strategic Plan, 2000).

Carbaryl is effective in controlling the cherry fruit fly but is ineffective against plum curculio. Due to the short residual activity for carbaryl, more frequent sprays are required when targeting cherry fruit fly which makes it more expensive. In addition, carbaryl is disruptive to beneficial mites and established IPM programs (Tart Cherry Pest Management in the Future: Development of a Strategic Plan, 2000).

There are no other alternative insecticides, either currently registered or in the pipeline which are efficacious enough to meet the zero tolerance requirements for these pests on sweet cherries.

There are no cultural practices which can control these pests as a stand alone option. However, orchard monitoring programs have significantly reduced OP applications through border row spraying and alternate row spraying as opposed to entire orchard application. Pest numbers can be reduced, however, through the use of ethephon as a loosener to help harvest a high percentage of the fruit. Similarly, removal of alternate hosts, including abandoned orchards can reduce pest densities (Tart Cherry Pest Management in the Future: Development of a Strategic Plan, 2000).

No effective biological control options are available for either pest at this time (Tart Cherry Pest Management in the Future: Development of a Strategic Plan, 2000).

Use in the Western Region:

Target Pests: - Pests which are targeted for control with azinphos-methyl in sweet cherry production in the western U.S. are Western cherry fruit fly, Syneta beetle (Oregon only), and Leafhopper (Mountain and Cherry) (Sweet and Sour Cherry, 2000 PNW Insect Management Handbook).

Western cherry fruit fly

Cherry fruit fly cause damage in two ways: feeding by the adults and feeding by the larvae (Cherry Fruit Fly Fruit IPM Fact Sheet, 1993, Michigan State University, http://www.msue.msu.edu/vanburen/fcfly.htm). Little damage results from the egg puncture itself but a dimple will form around the puncture if fruit is stung while still green (Crop Profile for Cherries in New York, 2000). Primary damage results from larval feeding within the fruit. Infested fruits appear normal until the maggot is nearly grown, at which time sunken spots appear. Maggots and their frass within the fruit render the product unsalable. Infested fruit is more susceptible to disease (Cherry Fruit Fly Fruit IPM Fact Sheet, 1993, Michigan State University, http://www.msue.msu.edu/vanburen/fcfly.htm).

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Leafroller (Fruittree, Obliquebanded, and Pandemis)
Leafroller larvae chew into opening buds and mine after hatching. Many buds may be destroyed before they open. Newly emerged larvae may make their way down between the buds in the clusters and chew into tiny stems and buds. Such injuries weaken the fruit so that even if flowers are fertilized, the fruit will drop. Just before the blossoms open, larvae may make their way inside and web the petals together so that they are unable to open and fertilization cannot occur. At petal fall, the half-grown larvae chew into newly set fruit. The more seriously injured fruit will drop; those that remain on the trees to harvest heal over with depressed russet scars. As the season progresses, the larvae confine their feeding to the foliage and cause some degree of defoliation. There is only one generation per year (Fruittree Leafroller, Michigan State University Fruit IPM Fact Sheet, 1998, http://www.msue.msu.edu/vanburen/frtrelr.htm).

Syneta beetle
Syneta beetle is a small, pale leaf-and fruit-feeding beetle that causes fruit scarring shortly after pollination through the time cherries are pinhead size. It is a localized problem in the Willamette Valley in Oregon and within orchard blocks. Adults begin emerging and feeding in orchards before bloom or as late as early fruit set. First emergence has been as early as April 6 or as late as early May depending upon elevation and slope of individual blocks. Beetles may be present for 4-6 weeks in an orchard. Best time for control is prebloom (popcorn) if beetles are present (Cherry 2001 Pest Management Guide for the Willamette Valley, Oregon State University, EM 8329).

Cherry leafhopper
Cherry leafhopper adults are active during three periods: mid-April through May; during July; and September through October. This leafhopper is an efficient vector of cherry buckskin and appears to be responsible for severe outbreaks of this disease. Cherry buckskin disease is a major cause of cherry decline and the cause of serious losses of sweet cherry trees in areas of California (Cherry Leafhopper, UC Pest Management Guidelines, Statewide Integrated Pest Management Project, http://www.ipm.ucdavis.edu/PMG/r105301811.html).

Alternative Pest Control Methods:

Western cherry fruit fly
Insecticides recommended to control Western cherry fruit fly include diazinon, malathion, dimethoate, esfenvalerate, methoxychlor, carbaryl, and spinosad. Multiple applications of carbaryl may cause mite problems. Malathion may cause leaf injury and is applied by air only with equipment adapted for ULV. However, aerial applications of malathion (Cythion) are the preferred and most effective method of control as large orchards, 200-400 acres or more, do not lend themselves to timely regular ground applications. Carbaryl is not used season long due to time constraints. Diazinon may mark light colored cherries and export restrictions may prohibit use of diazinon. Dimethoate use is limited to one spray per season, may cause leaf burning, and is not for use on cherries to be marketed in Japan (Cherry 2001 Pest Management Guide for the Willamette Valley, Oregon State University, EM 8329; Sweet and Sour Cherry, 2000 PNW Insect Management Handbook, Cooperative Extension Services of Oregon State University, Washington State University, and the University of Idaho; and Crop Profile for Cherries (Sweet) in Oregon , 1999, USDA).

Fruittree leafroller
Leafrollers in cherries can be controlled using *Bacillus thuringiensis* (*Bt*), spinosad, endosulfan, and carbaryl. Spinosad should be used against young larvae. As *Bt* is a stomach poison, complete coverage is essential and may require 2 to 3 applications. However, this pest has

demonstrated a capacity to develop resistance rapidly to chemical controls (Cherry 2001 Pest Management Guide for the Willamette Valley, Oregon State University, EM 8329; Sweet and Sour Cherry, 2000 PNW Insect Management Handbook, Cooperative Extension Services of Oregon State University, Washington State University, and the University of Idaho; and Cherry, UC Pest Management Guidelines, Statewide Integrated Pest Management Project http://www.ipm.ucdavis.edu/PMG/r105301811.html).

Syneta beetle
Syneta beetle is unique to Oregon. Phosmet is primarily used to control this pest under a Section 24C label. Alternatives to phosmet are azinphos-methyl and endosulfan (Cherry 2001 Pest Management Guide for the Willamette Valley, Oregon State University, EM 8329 and Sweet and Sour Cherry, 2000 PNW Insect Management Handbook, Cooperative Extension Services of Oregon State University, Washington State University, and the University of Idaho).

Phosmet: - Phosmet use on sweet cherries is limited to Oregon (Section 24C registration). No registration is available in other states largely due to phytoxicity problems on sweet cherries. In 1999, phosmet was applied to 10% of Oregon sweet cherry acreage. There was on average 1 application at a rate of 0.81 lbs. a.i./acre/application. The pest which is targeted for control using phosmet is the Syneta beetle.

Target Pests: - The pest which is targeted for control using phosmet is the Syneta beetle.

Syneta beetle
Syneta beetle is a pest in the Willamette Valley, Oregon. Adults emerge in the spring and chew holes in foliage and fruit stems. Immature cherries are scarred and deformities result. Insecticidal control is required between early popcorn stage and petal fall. Most feeding damage occurs on pinhead and smaller size fruit (Cherry 2001 Pest Management Guide for the Willamette Valley, Oregon State University, EM 8329 and Sweet and Sour Cherry, 2000 PNW Insect Management Handbook, Cooperative Extension Services of Oregon State University, Washington State University, and the University of Idaho).

Alternative Pest Control Methods: There are only two other insecticides which are recommended to control Syneta beetle in sweet cherries. These are azinphos-methyl and endosulfan.

Restricted Entry Intervals
Azinphos-methyl:

Current label REIs	REI= 14 days hand harvest / hand thin* 2 or 3 days for all other activities.
PHI	15 days

Phosmet:

Current label REIs	REI= 24 hours for all activities (5 day for all activities in CA)
Registrant proposed REI's	7 days for hand harvest
PHI	7 days

* Propping and hand thinning are not performed in the production of sweet cherries.

Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

IMPACTS ON CROP PRODUCTION*:*

Azinphos-methyl: There could be a major impact on sweet cherry production from extension of the REI. Sweet cherries are not hand thinned (ie. rely on natural fruit set) but are hand harvested. Extension of the REI would generally cause producers to switch to a product with a lesser REI, such as synthetic pyrethroid, for late season pest control. Fruit flies are a major sweet cherry pest in both production regions and must be controlled within the eight day pre-oviposition period before the female matures and she can lay eggs. Due to California Department of Agriculture regulations, there is zero tolerance for this pest. Extension of the REI beyond the current label would put the complete crop at risk as a result of using less efficacious alternative insecticides.

Phosmet: There should be minimal impact from extension of the REI as this product is only targeted to control Syneta beetle in Oregon and is applied early in the growing season. Phosmet is not used on other sweet cherries due to phytotoxicity issues.

REFERENCES

Marks Fruit Page, http://www.uga.edu/hortcrop/rieger/index.html#Crops, Dept. of Horticulture, University of Georgia

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